(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
27 September 2001 (27.09.2001)

PCT

(10) International Publication Number
WO 01/70471 A1

(51) International Patent Classification[6]: B27B 33/08, B23D 61/02

(21) International Application Number: PCT/US01/09061

(22) International Filing Date: 20 March 2001 (20.03.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/191,043 21 March 2000 (21.03.2000) US
09/637,473 11 August 2000 (11.08.2000) US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

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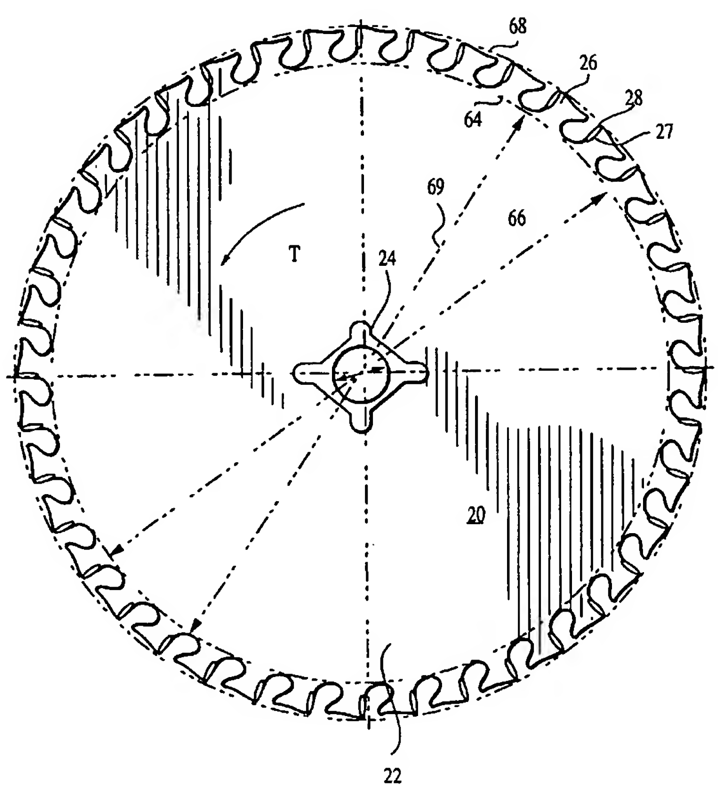
(54) Title: METAL-CUTTING SAW BLADE HAVING STRENGTHENED GULLET AND NEGATIVE TOOTH RAKE



(57) Abstract: A rotary saw blade for cutting a metal workpiece. The blade includes a generally circular main body plate (22) having an opening (24) at the center of the plate and a plurality of raised tooth support members (26) disposed about the periphery of the plate. Each of the support members has a tooth attachment portion (27) generally facing the direction of rotation of the blade and a peripheral guide member (32) extending away from the tooth attachment portion. A plurality of cutting teeth (28) are each mounted on one of the tooth attachment portions. Each of the tooth support members define gullets (60) between each of the guide members and extending generally radially inwardly toward the center of the blade. The gullets are further defined by a throat area (70) and a rounded area (62), wherein the throat area defines a gap width (10) between a peripheral guide member and a tooth.

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METAL-CUTTING SAW BLADE HAVING STRENGTHENED GULLET AND NEGATIVE TOOTH RAKE

CLAIM FOR PRIORITY

The present patent claims priority to U.S. Provisional Application Serial Number 60/191,043, entitled METAL-CUTTING SAW BLADE HAVING STRENGTHENED GULLET AND NEGATIVE TOOTH RAKE, filed on March 21, 2000.

BACKGROUND OF THE INVENTION

The present invention relates to rotary saw blades for cutting thin-gauge metal sheeting. In particular, the present invention relates to a saw blade having a strengthened gullet structure and a tooth rake combination for efficiently cutting metal workpieces.

Portable electric rotary tools are often used to make cuts in metal workpieces at a worksite. Typically, non-toothed grinding blades are used on stationary tools for trimming smaller workpieces, while different blades are used in conjunction with handheld tools to make longer, more substantial cuts in the metal. These longer cuts often require a toothed blade to provide more aggressive movement through the workpiece. This is time-efficient and also prevents the excessive buildup of heat caused by friction between the blade and the metal.

Toothed blades typically include peripheral tooth supports projecting radially from a round metal plate. To control kickback and guide the teeth attached to the supports, anti-kickback shoulder structures are often provided ahead of each tooth. These typical structures as available in the prior art, for example in U.S. Patent No. 5,261,306 to Morey et al., may not be appropriate for cutting metal. Use of such blades for cutting metal sheeting may compromise the life of the blade and may be dangerous to the user.

Moreover, the deterioration of a conventional blade structure or a conventional metal blade cutting structure will often contribute to inaccuracies in the cut. As more aggressive blades are used in metal, warping caused by

frictional heat and stress damage may cause the teeth to fall out of alignment. This results in uneven cut edges or chipped edges in the workpiece.

There is therefore a need for a blade structure more tailored to the needs of aggressive metal cutting applications.

BRIEF SUMMARY OF THE INVENTION

To obviate one or more of the above shortcomings, one embodiment of a rotary saw blade for cutting a metal workpiece is provided. The blade includes a generally circular main body plate having an opening at a center of the plate and a plurality of raised tooth support members disposed about the periphery of the plate. Each of the support members has a tooth attachment portion generally facing the direction of rotation of the blade and a peripheral guide member extending away from the tooth attachment portion. A plurality of cutting teeth are each mounted on one of the tooth attachment portions. Each of the tooth support members define gullets between each of the guide members and extending generally radially inwardly toward the center of the blade. The gullets are further defined by a throat area and a rounded area, wherein the throat area defines a gap width between a peripheral guide member and a tooth. Preferably, a portion of the rounded area is located substantially forwardly of the throat area.

In another aspect of the invention, another embodiment of a rotary saw blade is provided wherein the plurality of raised tooth support members have a forwardly directed tooth attachment portion generally facing the direction of rotation of the blade and a peripheral guide member having a finger extending rearwardly away from the tooth attachment portion. Each of the cutting teeth are mounted on one of the tooth attachment portions so that a radially outermost edge of the tooth is positioned at an angle between approximately 0 and 7 degrees from a radial line on the blade. Each of the support members, fingers and teeth substantially define a gullet having a throat area and a rounded area located radially inwardly from an outer circumference of the blade.

The invention may also be embodied in a method for cutting a metal workpiece. The method includes the steps of providing a hand-held power tool, attaching a generally circular blade to the power tool, and cutting the workpiece using the power tool and the blade. The blade includes a main body plate having an opening at a center of the plate and a plurality of peripherally spaced tooth support members. Each of the support members has a tooth attachment portion inclined negatively relative to a radius of the blade, and successive ones of the support members define gullets having a throat area and a rounded area. The throat area defines a gap width substantially smaller than the radius of an arc of the rounded area.

The present invention therefore provides a saw blade having a unique structure to allow the efficient and accurate cutting of thin metal workpieces. The negative tooth rake angle is integrated into the structure of the blade tooth support to provide greater strength to the overall blade while allowing the teeth to make smoother cuts into the workpiece. Furthermore, the stocking-shaped gullet structure defined between tooth supports efficiently spreads the linear tensile forces along the elongated, rounded edges of the gullet to more efficiently absorb the stress produced by the guide structures and the tooth supports.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed. The invention, together with further objects and attendant advantages, will best be understood by reference to the following detailed description, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF SEVERAL VIEWS OF THE DRAWINGS

These and other advantages of the present invention will become more fully apparent as the following description is read in conjunction with the drawings, wherein:

FIG. 1 illustrates a plan view of one embodiment of the rotary saw blade of the present invention;

FIG. 2 illustrates a detailed plan view of a circumferential edge section of the saw blade similar to that of FIG. 1 in a modified second embodiment having the teeth removed from the blade;

FIG. 3 illustrates a detailed plan view of a circumferential edge section of the saw blade of FIG. 1 with the teeth installed to the blade;

FIG. 4 illustrates an edge plan view of the blade of FIG. 1;

FIG. 5 illustrates a detailed view showing the forward face of one tooth and associated blade structure of the embodiment of FIG. 1; and

FIG. 6 illustrates a detailed view similar to that of FIG. 5 showing the forward face of another tooth of the embodiment of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Referring to the figures, FIG. 1 shows a side view of the circular saw blade 20 in a preferred embodiment having forty teeth. Other numbers of teeth may be implemented. The preferred blade 20 preferably includes a plate 22 having a 5/8-inch hole 24 defined in the center thereof for mounting the saw blade 22 onto an arbor. Preferably, the metal plate 22 is generally circular in shape and is machined from flat-surface tool steel, and the thickness of the blade is approximately .063 inches. The arbor hole 24 is preferably for use on standard arbors for hand-held circular saws.

In this embodiment, a plurality of raised tooth support members 26 are distributed about the periphery of the plate 20. The support members 26 preferably include forward portions attaching cutting teeth 28 on a tooth attachment portion 27 of each support member 26. Each tooth is preferably made from carbide, or other suitable hard material. As shown more clearly in FIGS. 2 and 3, each tooth includes a reverse-beveled outer cutting edge 31 positioned at the outermost circumferential extent of the blade 20, a contact face 33, a bottom inward face 35 and a rear face 37 extending generally parallel to the contact face 33. Each tooth 28 is preferably brazed to the saw plate 22 at points of contact of the rear face 37 and the bottom face 35 on a

stepped forward edge portion 29 of the tooth attachment portion 27 of each support member 26.

The tooth support members 26 generally extend rearwardly from each tooth 28 at a radial distance less than that traced by the cutting edge 31 of the tooth 28. The rearmost receding portion of the member 26 extends as a finger 32 directed towards a succeeding tooth 28. The outermost edge 40 of the support member 26 preferably traces a v-shaped arc or valley 42 at a radial distance less than the outermost cutting edge of the tooth 28. The receding configuration of the edge 40 allows only a minimal amount of the blade plate 22 to contact the cut portion of the metal workpiece after the cut is made by each tooth 28. The finger portion 32 further acts as a guide to prepare for the cutting entry of the succeeding tooth 28 rearwardly of the finger portion 32.

The outermost edge 40 of the tooth support member 26 includes a generally straight inwardly sloping portion 44 and an outwardly sloping portion 46. The sloping portions 44 and 46 on each member 26 preferably meet in a peak 48. The two portions 44 and 46 preferably meet at angle β, which preferably is 170 degrees. The peak 48 may be either a sharp edge or a slightly rounded portion having a radius smaller than approximately 2 mm. In the preferred embodiment, the inwardly sloping portion 44 has a length l1 and the outwardly sloping portion 46 has a length l2. Preferably, the length l1, which is approximately 0.22 inches in the preferred embodiment, is longer than the length l2, which is preferably 0.15 inches in the preferred embodiment. Although other lengths and angles may be utilized, however, it has been found that these dimensions produce the most desirable results in the preferred embodiment.

Preferably, the teeth 28 in the preferred embodiment are formed from a carbide metal material and the hook or rake angle α of the cutting face 33 is in a negative relationship with the radius of the blade 20. In particular, the rake angle $\forall$ of the cutting face 33 is approximately 5 degrees relative to a radial line 50 from the center of the blade 20. It has been found that for the preferred embodiment and its application to cutting metal workpieces, the

rake angle may effectively be varied between 0 and 7 degrees from the radial line 50. It should be noted that other tooth materials, such as other hardened metals, may also be utilized.

As indicated in FIG. 1, in the preferred embodiment, the inner circumference is preferably approximately 6.54 inches in diameter as shown by diameter line 66. The circumference of cut 68 is preferably approximately 7.25 inches in diameter as shown by diameter line 69, which extends to the outermost cutting edges 31 of the teeth 28.

Referring back to FIGS. 2 and 3, open gullets 60 are defined inwardly between successive tooth support members 26. In particular, the gullets 60 are defined by an interior edge 62. The edge 62 comprises the inwardly extending portion 32a of the finger 32 of the rear portion of the support member 26 and continues in a stocking-shaped formation to an inner circumference 64 at the maximum depth of the gullet 60. The edge 62 then proceeds outwardly to curve toward the successive tooth area and tooth attachment portion 27.

As noted above, the finger 32 projects rearwardly toward the succeeding tooth support member 26. The gullet 60 is initially defined by a throat area 70, which extends between a rear edge 32b of the finger 32 and the cutting face 33 of the succeeding tooth on the succeeding tooth support member 26. The throat area preferably defines a gap width.

The rear edge 32b of the finger 32 includes an interior edge 62. The edge 62 further defines the lower portion of the gullet 60 by defining a first arc having radius R1 below the finger 32. A forward arc 62a having a substantially semicircular trace and radius R2 comprises a forward portion of the gullet 60. The arc 62a is preferably located substantially forwardly of the throat area 70. The forward arc 62a transitions to a lower arc 62b, which preferably has a longer radius. Finally, the lower arc 62b transitions to a radially outward direction via a transition arc 62c having a radius R4. This arc 62c preferably joins the cutting face 33 and extends the final portion of the gullet 60 towards the throat area 70. While other radii and arc profiles may be utilized and would of course change with the numbers of tooth supports, the

size of the blade, etc., it has been found that the present values produce the best results in the preferred embodiment.

In order to support the face 33 of the tooth 28 at the preferred angle range of between 0 and 7 degrees to a radius line of the blade, the attachment portion 27 is preferably angled in a similar fashion relative to the radius of the blade 20. In the preferred embodiment of FIG. 3, the attachment portion 27 is a notched or stepped portion extending inwardly into the tooth support member 26 by .075 inches. Other attachment interface methods for the teeth 28 may be utilized. For example, the stepped portion of the attachment portion 27 need not be utilized at all, and the teeth 28 may be brazed directly onto a non-stepped surface as shown in the second preferred embodiment of FIG. 2.

FIG. 4 shows an edge view of the blade 20. In the preferred embodiment as shown, the largest thickness of the blade 20 is at its outermost point on the top of the cutting edge 31 of each tooth 28. This distance, indicated as d1, is preferably .0795 inches thick. The blade 20 has its smallest thickness at a uniform plate thickness of .063 inches, as indicated by distance d2.

FIGS. 5 and 6 show edge views of the tip portions of the blade 20 of FIG. 1. As shown in the drawing, each tooth 28 has a sloped cutting edge 31c and 31d extending toward an edge of the blade 20 from the approximate midpoint of the cross-section of the blade. The remaining portions 31a and 31b of the cutting edge 31 extend horizontally along the axis of rotation of the blade 20. In the preferred embodiment, the sloped cutting edges 31c and 31d on alternating tooth support members 26 are angled 20 degrees downwardly from the horizontal portions 31a and 31b, respectively. This is indicated further as angle P in FIG. 4 above.

In use, the user will preferably attach the blade 20 to a hand-held or otherwise portable electric saw by tightening the arbor hole 24 around a shaft. The user will then operate the saw so that the blade turns in the direction T as indicated in FIG. 1 to cut through a metal workpiece. Preferably, the

maximum speed of the blade is 8300 RPM. The preferred speed of the blade is approximately 4000 RPM.

Of course, it should be understood that a wide range of changes and modifications could be made to the preferred embodiment described above. Thus, it is intended that the foregoing detailed description be regarded as illustrative rather than limiting and that it be understood that it is the following claims, including all equivalents, which are intended to define the scope of this invention.

CLAIMS

1. A rotary saw blade for cutting a metal workpiece, said blade comprising:

a generally circular main body plate having an opening at a center of said plate;

a plurality of raised tooth support members disposed about the periphery of said plate, each of said support members having a tooth attachment portion generally facing the direction of rotation of said blade and a peripheral guide member extending away from said tooth attachment portion; and

a plurality of cutting teeth, each of said teeth being mounted on one of said tooth attachment portions;

each of said tooth support members defining gullets between each of said guide members and extending generally radially inwardly toward said center, each of said gullets being defined by a throat area and a rounded area, said throat area defining a gap width between a peripheral guide member and a tooth, a portion of said rounded area comprising an arc located substantially forwardly of said throat area.

2. The blade of claim 1 wherein each of said teeth includes a cutting edge at the outermost portion of said blade and a contact face, said contact face having a negative rake angle.

3. The blade of claim 2 wherein said contact face extends at a rake angle of approximately 5 degrees from a radial line extending from the center of said plate.

4. The blade of claim 1 wherein said tooth attachment portions further comprise generally straight edges extending approximately 5 degrees from a radial line extending from the center of said plate.

5. The blade of claim 5 wherein each of said teeth includes a contact face extending parallel to a rear tooth face opposite said contact face, said rear tooth face being mounted to and aligned with said tooth attachment portion on said plate.

6. The blade of claim 1 wherein said rounded area includes an arc having a radius at least twice said gap width of said throat area.

7. A rotary saw blade comprising:

a generally circular main body plate having an opening at a center of said plate;

a plurality of raised tooth support members disposed about the periphery of said plate, each of said support members having a forwardly directed tooth attachment portion generally facing the direction of rotation of said blade and a peripheral guide member having a finger extending rearwardly away from said tooth attachment portion; and

a plurality of cutting teeth, each of said teeth being mounted on one of said tooth attachment portions so that a radially outermost edge of said tooth is positioned at an angle between approximately 0 and 7 degrees forwardly from a radial line through a bottom edge of said tooth;

each of said support members, fingers and teeth substantially defining a gullet having a throat area and a rounded area radially inwardly from an outer circumference of said blade.

8. The blade of claim 7 wherein said rounded area further comprises a generally oval-shaped area defined by an interior edge of said blade, said interior edge having a length substantially longer than the radial depth of said gullet.

9. A method of cutting a metal workpiece, said method comprising the steps of:

providing a hand-held power tool;

attaching a generally circular blade to said power tool, said blade including a main body plate having an opening at a center of said plate, a plurality of peripherally spaced tooth support members each having a tooth attachment portion inclined negatively relative to a radial line of said blade, successive ones of said support members defining gullets having a throat area and a rounded area, said throat area defining a gap width substantially smaller than the radius of an arc of said rounded area, and

cutting said workpiece using said power tool and said blade.

10. The method of claim 9 wherein said blade further includes a cutting tooth mounted to each of said tooth attachment portions, said teeth each having a cutting edge located at the radially outermost portion of said tooth and a face inclined at an angle between 0 and 7 degrees relative to said radial line so that said radially innermost portion of said tooth is angled toward the cutting direction of said blade from a radial line extending to said cutting edge from said center.

11. The method of claim 10 wherein each of said tooth support members further comprises a peripheral guide member adjacent the rearward portion of each tooth attachment portion, said peripheral guide member having a rearwardly projecting finger portion defining one side of said throat area.

12. The method of claim 11 wherein said finger portion further comprises an outer edge radially inwardly from the outermost circumference of said blade, said edge defining a valley-shaped recess.

13. The method of claim 12 wherein said gullets further comprise stocking-shaped openings.

14. The method of claim 13 wherein each of said tooth attachment portions further comprises a stepped section defined within said tooth support members adapted to partially retain one of said teeth.

15. The method of claim 14 wherein each of said stepped portions contacts at least a rear face and a bottom face of said tooth.

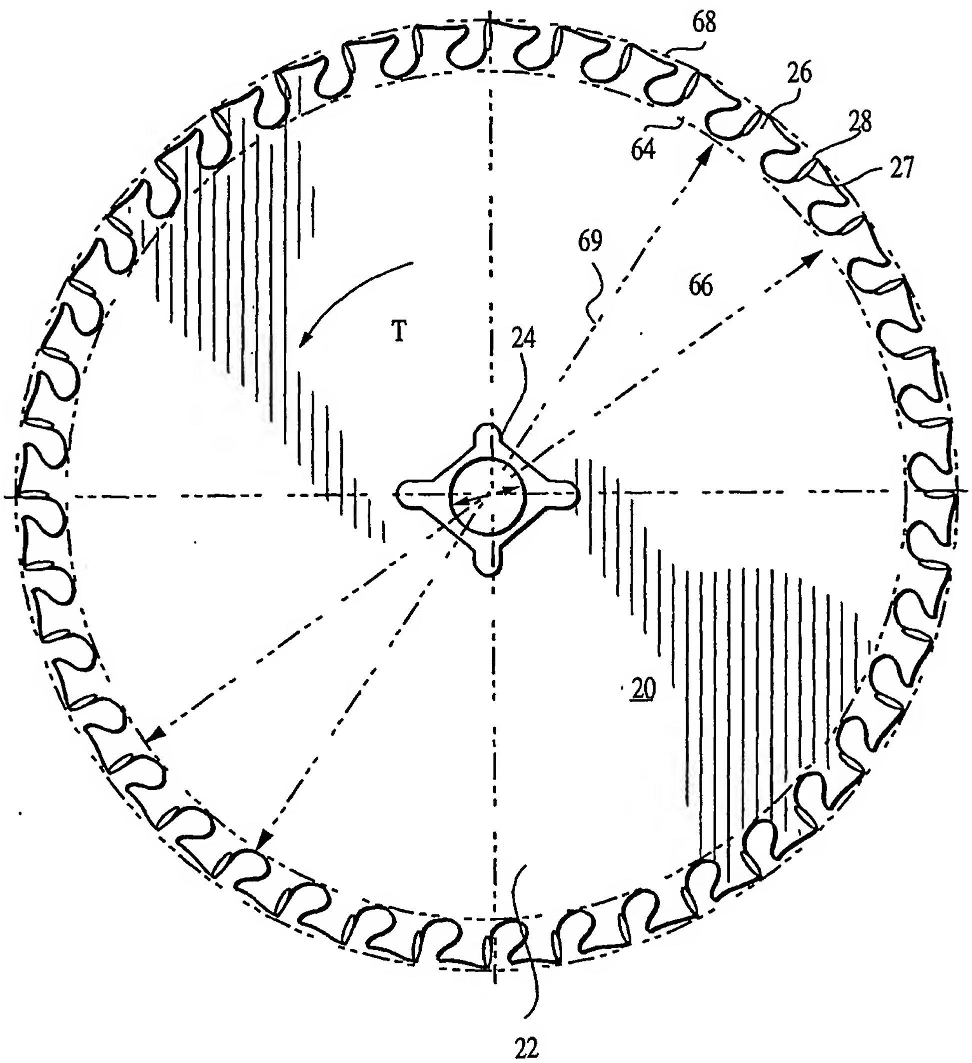

FIG. 1

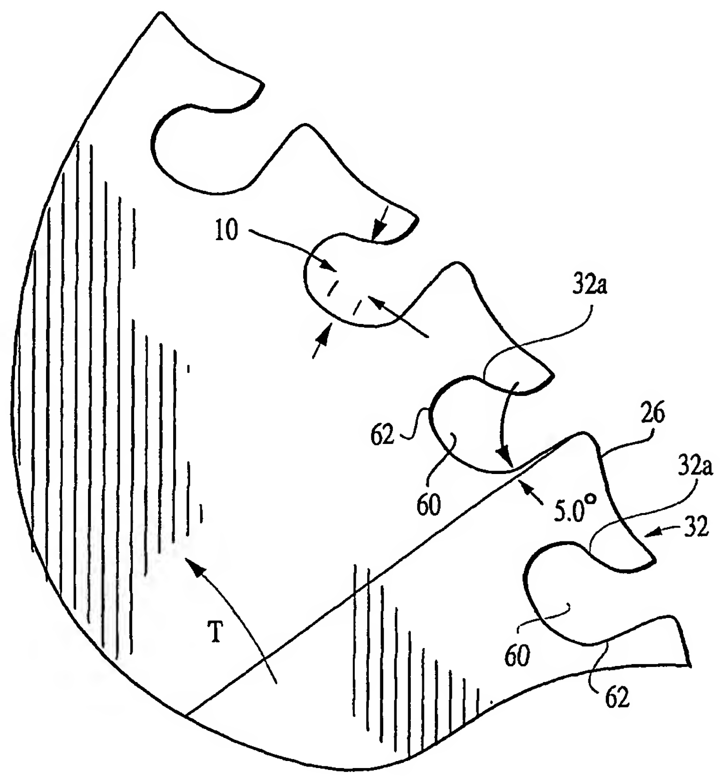

FIG. 2

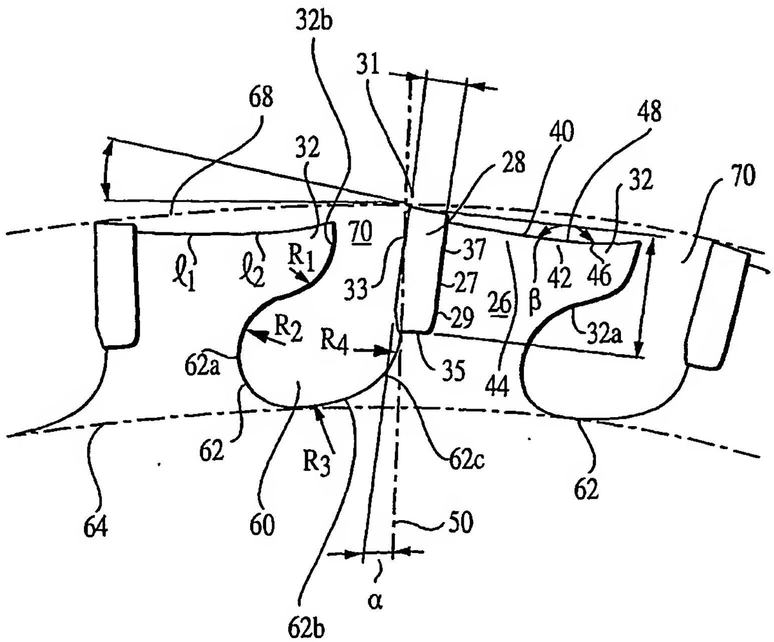
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FIG. 3

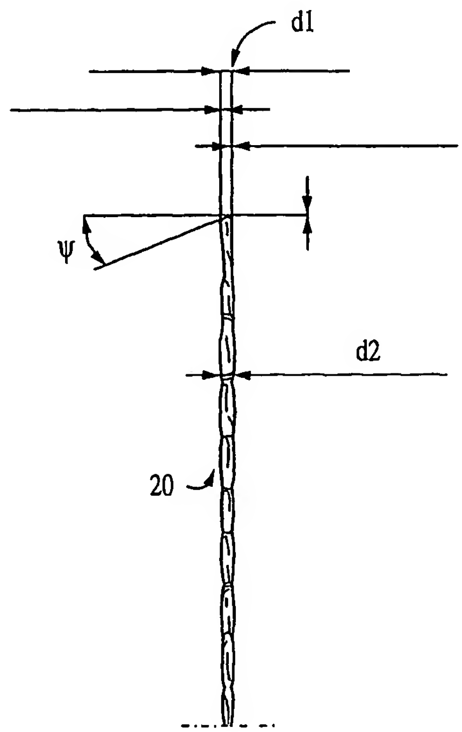

FIG. 4

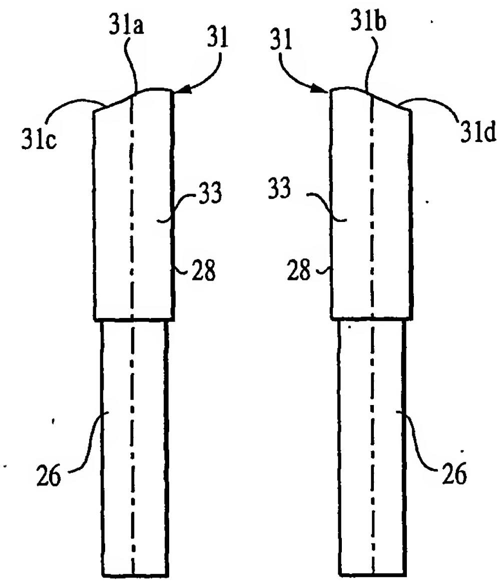

FIG. 5 FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/09061

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : B27B 33/08; B23D 61/02
US CL : 83/835, 676
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 83/835, 676, 846, 854

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,555,788 A (GAKHAR et al.) 17 September 1996 (17.09.1996), column 5, lines 5-15, see abstract and Figures.	1-15
X	US 5,054,354 A (KUBIS) 08 October 1991 (8.10.1991), column 3, lines 5-20 and 60-67, see abstract and Figures.	1-15
X	US 4,889,025 A (COLLETT) 26 December 1989 (26.12.1989), column 3, lines 10-50, see abstract and Figures.	1-15
A	US 4,432,264 A (SCOTT) 21 Feburary 1984 (21.02.1984), See abstract and Figures.	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search 18 May 2001 (18.05.2001)	Date of mailing of the international search report 13 JUN 2001
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